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ABSTRACT

Drawing on results from informal reading inventories and studies of oral reading behavior, a theory is presented to describe the process of learning to read. Reading is seen to be broader than a skill and more like a repertoire with many abilities, aptitudes, and special accomplishments performing in concert. This repertoire is acquired in four developmental cluster periods where the skills to be learned within a cluster are acquired in a nonlinear fashion. Linearity is important in the period between clusters as the reader struggles to achieve new structures of knowledge. This linearity between clusters supplies guidance and support when the learning challenge is greatest, that is, during the time of breaking out of one developmental period and breaking into another. (Author/AA)

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Acquisition of a Reading Repertoire

WILLIAM R. POWELL

WHY give special attention to a topic concerned with the process of reading? Is it because of the exponential power of reading behavior? Is it because of the insatiable desire of man to have control over the power potential of his dynamic behaviors? Or is it because it offers a simple mystery to which the detective nature of man must curiously seek to solve?

Certainly, if one wishes to have complete control over any system, he has to have an understanding of the process inputs within that system, otherwise the alchemy of change in the product will be due to chance regulation or control of the surface components. Unquestionably, reading behavior has exponential power. It is a generative process in that it gives the learner an increment of power to learn something else. And the greater the mastery over the process, the greater the degree of generative ability the individual has at his disposal.

Unfortunately, the process of reading cannot be reproduced through imitative behavior. According to Ray "the act of reading is one of the few human behaviors that cannot be learned through imitation of others performing the act."[1] An individual cannot reproduce the process in himself by simple observation and imitation of others performing that process. Undoubtedly, the receptive nature of the reading act contributes to the exclusion of mere imitation alone. This receptive process is uniquely personal, extremely complex, and involves all the experiential, perceptive, cognitive, psychomotor, and affective attributes of the human system. It is more than a skill; it is a repertoire of abilities, aptitudes, and special accomplishments assimilated into one active reticular performance.

However, to stipulate that reading cannot be learned imitatively does not imply that it cannot become habitual in nature at some

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stage of development. Indeed, habituation is possible and even probable unless some new element is added. Some novelty dimension must be given to the incremental process so as to disturb the equilibrium of the system and cause a new task to be solved. This would apply to the perceived simplicity of the learning of a letter or the assimilation of a new concept presented through verbal meaningful material.

This paper deals with three aspects of the process of learning to read: (1) the developmental clusters or time periods in which processing occurs; (2) the strategies of processing or acquiring these reading behaviors during these growth interludes; and (3) a theory for integrating the processing components. Obviously, this speculative paper is unsubstantiated by definitive research; the idiosyncratic position of the author has, however, been influenced by reported theories and individual research.

Developmental Clusters and Interfaces

The reading repertoire is acquired through four nonmutually exclusive cluster growth periods. These interlocking clusters have repeatedly been apparent in the data from studies of oral reading values for given levels of readability.[2] The range of these performance values tends to indicate a clustering of reading behavior which is a function of the difficulty of the material and not the age-grade factor of the reader. The four cluster periods are: (1) readiness through the preprimer readability (readiness PP); (2) primer through second grade (primer–2^2); (3) third-grade level to the end of fifth-grade readability level (3^1–5^2); and (4) sixth-grade reading level and beyond (6^1+). These clusters are illustrated in figure 1.

READINESS-PREPRIMER CLUSTER

In this initial cluster the individual must first learn the purpose of a writing system—that the symbol conveys a language message. Writing is a code that represents spoken language and is visually presented in such a way that the graphic display units stand in a fixed relationship to the units of the oral emission. Then the acquiring reader (hereafter, the reader) learns to code and recode that written message. Subsequently, the reader has to learn to combine letters, phonemes, and sound-symbol relationships

individually and collectively, and to recognize when to stop the combinatory process.

The medium is both spatial and temporal. After the reader learns to code each system, then he must learn to transform or recode one system into the other, i.e., in the initial instance to change the written code into the spoken framework he *already* possesses. Should he not have an adequate spoken language base, he obviously cannot perform the process of recoding, and to attempt to teach him to do so is futile, inefficient, and cruel. The reader must have an adequate prior spoken system in order to learn to code and recode a second system (reading) into it. Further, this spoken foundation must be more advanced than the level of performance initially demanded of the second system. To efficiently code and recode visually into the auditory system, the reader's spoken language process should be more mature than the level of the reading assignment. To code and recode at the preprimer level, the reader's spoken development should probably be a year to a year and one-half higher than that immediate instructional level. This difference between the two systems disappears gradually and becomes reversed at a later stage of development. During the initial cluster period, the acquiring reader learns to make the appropriate mapping assignments to the recurring intact units of each system, separately and in combination.

PRIMER–2^2 CLUSTER

In this second stage of development of the acquisition of a reading repertoire, the individual continues to learn the mapping assignments started earlier and learns additional alternate mapping routes which will increase efficiency. The recoding process matures and strategies for decoding develop slowly. As the reader learns to transform one system into another, he also learns to translate or carry the interpretative nuances of the prior system into the secondary one. To decode, some level of understanding, however simplistic, must be involved, and that level of comprehension is inherent in the prior language system. Having the prior (spoken) system at a more mature stage than this level facilitiates the ease of processing. Otherwise, the reader would have to learn two systems simultaneously. Given such a condition, learning would be confounded and difficulty would be intensified.

In addition to learning alternate mapping routes during this

cluster period, the reader should begin to reduce the amount of the mediation involved in the transformation between systems. The latency factor involved in conversion between the two language systems is reduced gradually until in a later cluster period it becomes nearly, if not really, simultaneous processing. The reader's equivalencies between the newly presented graphic symbol and the intact spoken counterparts demand less time for connections to become operational.

As the graphic display becomes more difficult either through meaning difficulty or increasingly embedded quality of information, the reader learns to utilize the prediction factor inherent in the syntactical nature of discourse. By learning to cluster the graphic presentation into a framework similar to the one that spoken language is naturally segmented into, the reader begins the process of reducing inefficiency and increasing information gained.

3^1–5^2 CLUSTER

The completion of the decoding function occurs during this cluster period, and as a consequence automatization occurs. The latency factor reduces considerably the mediational distance between equivalencies in word recognition and word-knowing until it reaches near instantaneous processing. However, during this growth period the decoding mechanism becomes so strong and accurate in processing that it can outdistance the underlying language systems. In essence, the individual can learn to call words, i.e., pronounce them accurately, but have no equivalency for it in the semantic characteristics of the language systems. Thus verbalizing occurs. The maturity of total language development must be of major concern through the learning process. One aspect or mechanism of learning cannot be overdeveloped at the expense of other language components.

An accent on recall is evident during this developmental cluster. The informational demand intensifies as does the length and complexity of the graphic arrays. There is added content depth and the retrieval of the information becomes more difficult. The gap widens between the surface and deep structure of the language. The shift between connotative and denotative meaning becomes more pronounced and more difficult to process. The individual becomes an independent reader during this period but not a mature one. However, as a person moves closer to the interface between this cluster and the succeeding one, the regression probabilities to lower

levels of performance becomes less likely; functional literacy is achieved.

6^1+ CLUSTER

With decoding abilities intact, the reader is now within the operational limits of his motivational dispositions, his genetic endowments, and his continued maturity in language acquisitions. He can increase his efficiency by lengthening his span of apprehension and reducing the latency factor for processing the amount of intake. He can literally learn to think using the printed page as the stimulus for reverberating his mental actions. While such limitations are not bound by instructional opportunities, experience has shown that direct instruction increases the probabilities that growth will occur in these more mature reading functions.

THE INTERFACES

Since the four clusters delineated above are not mutually exclusive, there must be area common to the interlocking concentrics. Figure 1 shows three interfaces (the shaded areas) between the four developmental clusters, and these offer the greatest possible opportunity for challenge and speculation.

Historically, it has been assumed that the skills needed in the acquisition of a reading repertoire must be linear, i.e., they are arrayed in the hierarchical order and this skill or that skill must be mastered before the next arbitrarily sequenced set is initiated. Indeed, much of the past and current research in the reading area has intuitively adopted this assumption. Further, the development of most of the reading materials commercially promoted is predicated on this assumption. Skill and sequence charts are elaborately developed and portrayed. In each instance, the linearity of the skills is implied and emphasized, if not explicitly formulated. In essence, the implication is that *this* specific skill must precede *that* specific skill — this first and then that. This results in an obviously stifling rigidity — both for a teacher and a learner.

The contention here is that there is a sequence, but that the sequence is between clusters and not within them. Given a set of skills and subskills relative to the difficulty of the language and the types of processing to be mastered, they are operative in a random fashion *within* the given developmental cluster. They operate in the same nonlinear manner as the other language processes.

However, between the developmental clusters or in the interfacing

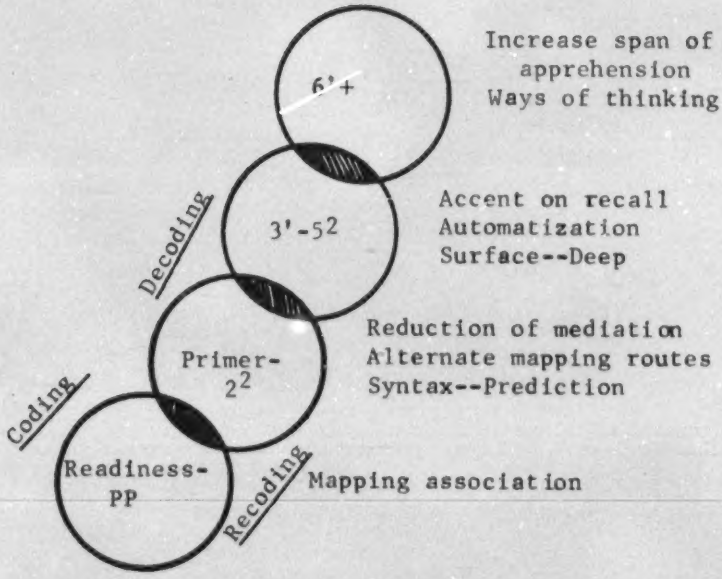

Fig. 1. Developmental Interfacing Clusters

period, the issue and substance of sequence is quite a different matter. Within the interfaces, sequencing becomes crucial and the linearity of skills is probably a necessity to aid the reader to evolve easily and efficiently out of one developmental period into a new stage of structural growth. It is to this interfacing area that research energies need to be devoted, in both identifying the crucial skills during that interluding space and in determining the order which maximizes the ease of transfer between the interlocking growth structures.

The greatest growth in the acquisition of a reading repertoire will be achieved at those times just before and just after each of the interfacing periods. Development and motivation will be easy to elicit during these accelerated learning episodes. Growth will be more vexing and frustrating for the learner while he is functioning within the interfacing periods; more direct and guided instruction will be needed for the great majority of individuals during these time spans due to the probable fact that skill learning within a developmental cluster is random or nonlinear and that between

clusters or during the interfacing periods skill acquisition probably follows a linear course.

Strategies for Processing Written Verbal Messages

A series of five functions which influence the acquisition of the reading repertoire will be presented in this section.[3] The five functions are: (1) the processing of recurring intact units; (2) the processing of spatio-temporal relationships; (3) the processing of semantic relations; (4) the processing of transformations; and (5) the processing of differential cognitive functions. Each processing stage will be briefly discussed and illustrated.

Processing recurring intact units

Whether the perceptual task is dealing with letters, sounds, or words, singly or in combination, the learning process follows a common pattern. A reader must first learn to make the appropriate mapping assignments both between and within graphic units (letters or words) or sounds (phonemes). Then he must process the key features of each unit and finally note its relationship to its invariant position in space. These four changes in reading behavior, subtle though they may be, are the critical perceptual tasks of learning to read.[4]

Discrimination—Differences Between Classes. Initially, the beginning reader must learn to see or hear differences between dissimilar sets. He must learn that *d* is a letter while + is not; that the combination of letters such as *work* is a word and the letter combination of *worh* is not. The beginner must scan temporally and make a response to a difference.

Recognition—Differences Within Classes. Bartlett contends that we notice differences and have to be taught to see similarities.[5] He stipulates that biologically we attend to the unusual in our environment because it is the unusual element in the environment which represents a threat to survival.

Once a reader can detect with facility the differences between sets, he must learn what, according to Bartlett, is the most difficult perceptual task—a response to sameness. The acquiring reader has to learn to respond to similarities *within* a commonly accepted cultural set. He has to learn that *t* and *t* are the same percept while *t*

and *l* are not. He must learn to hear that the sounds representing the two symbols *a* and *a* are similar while the sounds culturally attached to *a* and *o* produce accepted patterns such as /æ/ and /a/; and he must learn that the coding of the letters *w-o-r-k* and *w-o-r-k* are the same while the letter combinations of *work* and *word* are not the same.

Mapping Key Features. One of the characteristics which aids a learner in detecting similarities is their distinctive or key featuress. A beginner must learn the relationship of the components to its whole. He must learn to see that all *m*'s have two humps, while *n*'s have one hump. Acoustically he must learn to hear the presence or absence of sound in a word, a higher intensity or lower tone, etc. In the recognition of similar words, they must learn to detect the influence of ascenders or descenders, the effect of length, vowel complexity, and other orthographic factors. Whether it is an acoustical or visual pattern, the acquiring reader must learn the relationships within that set.

Mapping Units in Space. Visually, the beginning reader has to detect the relationships between the graphic unit and its placement in space. He has to learn form constancy and the effect of rotation and directionality on symbol units. The letters *b*, *d*, *p*, and *q* present the most difficult alphabetic directional confusion. Words such as *was* and *saw*, *no* and *on*, present similar orthographic difficulties in the larger intact graphic units. These, of course, represent examples of what is commonly called reversal errors in reading.

PROCESSING SPATIO-TEMPORAL RELATIONSHIPS

After the reader has learned the different patterns made by the same letters, the same sounds, and the same recurring units, he must acquire, if he has not already inductively acquired, the ability to know when to stop the combinatory process—an operation called coding. This combinatory process must be matched with the appropriate experiential or language base so that the symbolic function can be attached to it. In order to process the time-space relationships of sound-symbol relationships, the acquiring reader must learn (1) to make associations and (2) to be able to establish equivalents.

Making Associations. Before a reader can make the necessary associations between perceptual discriminations and recognitions he

must have a basis upon which to attach them. Samuels labels this as response availability.[6] There must be a meaning reservoir; this meaning reservoir is usually best indicated by the level of the speaking vocabulary which, as discussed above, should be more advanced than the present level of instructional effort. Colloquially, one would say he must have "something to hang it on." This "hanger" is a fusion of experiences, maturity, and language development. One caution should be stipulated here: vocalizing of a word does not provide assurance that the reader has a meaningful basis for it.

Given some assurance of a meaningful reservoir and of veridical perceptions, the routine process of determining the simple relationships between the two must be established. The reader must be able to attach permanent linkages between his discriminations and his stored meanings. Learning the association between these linkages (naming process) builds the bonds or the connections which cement the two together. Attaching a name (associates) between these relationships provides the glue to hold them together.

Short-term memory is involved in this associating stage of processing and the emphasis is more on the visual modality than on the auditory one. Auditory interaction is minimal. Essentially, the memory system here is more what is commonly called visual recognition than anything else. But there is some auditory input because of the auditory-vocal involvement with the interconnections involved with the "name."

Words in particular become conditioned stimuli as the result of this paired-associate process, and each carries with it the shaping, tinting, and nuances of it in the stored system. If, for example, a youngster has in his meaning reservoir an unfavorable meaning of *school*, *teacher*, *reading*, *mother*, *cop*, and so forth, these culturally imbued meanings are those which become conditioned to the printed stimuli. And these meanings may not be particularly the ones that are to be used in the contextual basis that is to be applied. Therefore, care must be exercised to explore the stored meanings which are being cemented in during this association stage.

Determining Equivalents. After associations are formed, the acquiring reader has to expand these to similar, but not identical, relationships. He has to learn that particular symbols, sounds, or meanings represent, or are equivalent to, a similar association. Therefore, he has to learn that A, a, *a*, and *a* are all common sets

which have the same name but are somewhat different in their visual configurations. Acoustically, it also is true that different letters can represent the same sound. For instance, the *e* in *be*, *eat*, and *feel*, all represent the same sound, but the visual representation is modified. The same is true for equivalencies in meanings which are represented by words that have the same meanings but differ visually (synonyms).

The long-term memory system is active in establishing equivalencies. The visual recall is instantaneous and the visual and auditory systems become highly integrated. Indeed, the assimilation or internal integration is completed so that the condition works anywhere, anytime. Categorization occurs, the meaning becomes firmly attached, and automatization can be developed.

Establishing equivalencies is a crucial process for the reader; otherwise he is always situation bound—limited to a specific stimulus for a specific response with no flexibility. He must learn that this grapheme, phoneme, word, or concept represented by a new but similar stimulus is equivalent to whatever the others are.

Learning Rate. Each individual has an approximate capacity of new inputs, whether they be letters, sounds, or words, that can be learned in a given time segment—a minute, an hour, a day, or a week. To exceed this absorption rate is to create a false economy. Should the speed of assimilation be exceeded, learning is confounded and little if any new learning occurs. Simply stated, overloading stalls or stops the mechanism of processing. Extension beyond a given individual's linkage ability and memory system inhibits positive learning and creates frustration.

Repetition. The basic mechanism for establishing associations and equivalencies is repeated exposure. Desired linkages have to be presented again and again in an interesting and meaningful arrangement. The modal number of presentations required for automatization to occur is undoubtedly a variable idosyncratic to a given individual. Not since the Gates study[7] in 1930 has any estimate of the number of appearances of words for instant recognition been given. Gates's data suggested that the number of exposures was a function of the ability level of the individual. For a person with average ability, he reported that thirty-five exposures is necessary for instant linkage. With the impact of modern technology this figure is probably higher than would be needed today for

individuals of average ability; twenty such repeated exposures might be sufficient for immediate sight recognition. But certainly many variables influence such an estimate, particularly items such as frequency, intensity, concreteness, etc. In any instance, the number of repetitions needed for automatization is probably larger than most people currently believe.

It would appear that the processing of intact recurring units requires a substantive input, a cementing factor, a regulator, and a seal or gasket. The substantive ingredients are the discriminations and the meaning reservoir. The cement or glue in the process is the associations and equivalencies. The regulator is the learning rate variable; and the required number of repeated exposures provides the seal for the process. It should be noted and emphasized that the process above is really *three* processes: one for letters, one for the sound system, and one for words. There will be minor modifications for each function, but essentially the mechanisms will be similar.

PROCESSING SEMANTIC RELATIONS

Reading, of course, is not just coding, recoding, and decoding functions. It is true that these operations are the more mechanical aspects of the reading process, but the principal function is to get the message which is intended or conveyed by an author through his printed words. There must be an active sense of awareness about the possible options presented and the alternate strategies for solution. The reader has to learn to reconstruct the intended meaning and match it with his existing structure of knowledge.

Reading is a form of abstraction, i.e., it is presented and processed in symbolic form. Any abstraction such as ideas in print must be directly relatable to the reader's level of abstraction. The information, ideas, or concepts presented must become internalized, integrated and assimilated. However, one must always be aware that the instrument of assimilation can register without internal integration. Some level of comprehension occurs when the language structure of the prose has been precorrected. Precorrection implies the reduction of errors or miscues both in word recognition and in meaning recognition on the reader's level of assimilation. The new information presented is experienced when it can be assimilated and has become internalized.

The techniques which facilitate the processing for semantic relationships are learning to set up expectancies and to anticipate

expected patterns, to interpret the space between words and sentences, to scan for meaningful clusters (of words), to utilize a contextual support system, to transpose typographical meaning signals into the conveyed message, to apply denotative and connotative meaning structures where appropriately demanded, and to track and retrack relationships embedded in prose even if separated sequentially.

PROCESSING TRANSFORMATIONS

In the acquisition of a reading repertoire, a necessary skill is the ability to manipulate or interpret manipulated syntactical complexes to extract the intended meaning. The reader has to learn to interpret substitutions and transformations. In learning the effect of substitution he sees the meaning change is replaced by one word with another word from the same class, i.e., a noun replaces a noun, a verb another verb, an adjective another adjective. In high frequency patterns, only one class is changed. However, the reader begins to sense a change can be made in several ways singly and in combination: a change in person, tense, word order (negation, question), etc. A simple illustration would be that the sentence "I have a name." can be modified by changing the last word to "pencil," "bicycle," "toy," etc. In each instance the meaning change is due a change within a class.

Meaning shifts are frequently accomplished through transformation of the syntax. Transformation occurs when one stimulus pattern is transformed into another pattern. In the process, some modification in meaning normally transpires, whether it be a shift from active to passive action, or affirmative to negative, or affirmative to interrogative, etc.

One subtle example is the conversion of the stimulus sentence, "Mother made the cake." to the passive forms of "The cake was made by Mother."

PROCESSING OF DIFFERENTIATED FUNCTIONS

Grammatical complexity or syntax obviously affects the nature of semantic relations, but not to the exclusion of other psychological functions. Many of the so-called higher level comprehension skills are probably more psychological than linguistic, but the degree of contribution from each segment of the psychological-linguistic continuum is a function of the specific skill under consideration.

Unfortunately, most of the research pertaining to this complex network has tended to make certain a priori assumptions about the nature of the skill instead of attempting to account for the variance contributed from each sector. Therefore, most remarks about the nature of these skills tend to reflect more ideology than veracity.

Processing prose material differentially involves the manipulation of semidiscrete functions simultaneously. The reader has to mentally handle intentional factors, content factors, and response factors in various combinations and degrees of completeness. Intentional factors include such items as the meaning reservoir, the purpose for reading, and the passage length. Content factors would involve such items as the level of difficulty (readability); the type of literature narrative, expository, argumentative or descriptive; and the interest value to the reader. Whether the response mode is to be one of recognition, or recall, or to be integrative, exact, or elaborate will influence the differential understanding of the task.

From the acquiring reader stage to the maturing reader stage, the reader has to learn how to deal with and control the many sets of variables presented to him both linguistically and psychologically. As his span of apprehension increases, he must learn to differentially manipulate the correct set of psycholinguistic variables so that he truly begins to use the printed page as a stimulus for thinking. As he restructures it, i.e., precorrects his errors, and internalizes the message, it then becomes a part of his experience and meaning reservoir and becomes available for further additive restructuring.

The Reduction Theory on Processing of the Reading Repertoire

BASIC PARADIGM

The reading process is depicted here as a problem-solving activity which arises by uncertainty introduced into the system which must be reduced by precorrection in the basic mechanisms directly influencing the imbalanced states: word recognition, semantics, and time. The less the reduction (precorrection) necessary, the greater the potential for increased cluster intake and the rapidity of processing. The active states find a match in the stimulus, tension is reduced, and the problem is solved. Figure 2 presents the basic paradigm of this process.

Problem-Solving Behavior. A problem can be defined as a situation in

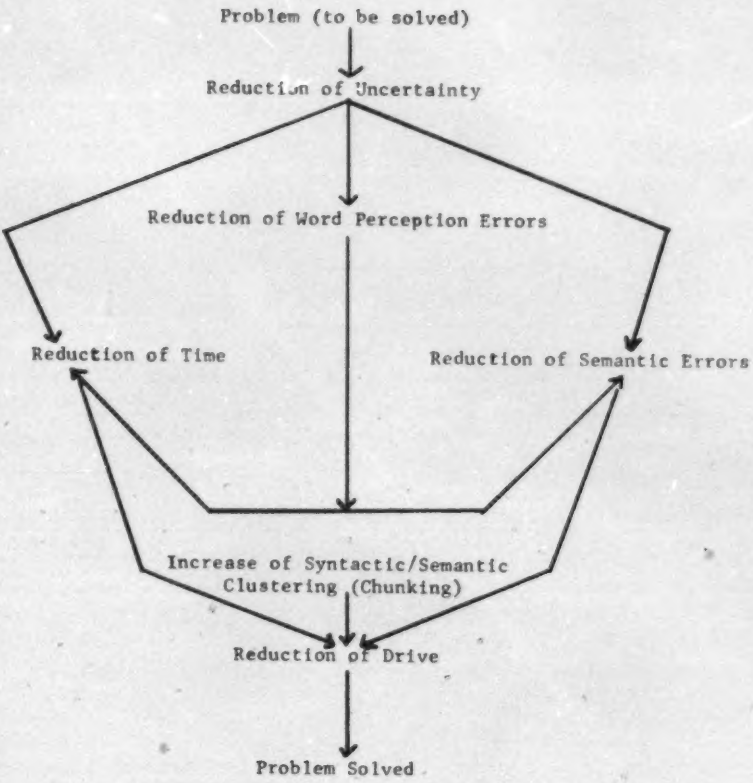

Fig. 2. Reduction Theory on Processing of the Reading Repetoire

which the organism's first attempt is unsuccessful in attaining a desired goal. That desired goal could be to pronounce a word which is outside the reader's existing sight vocabulary; it could be to determine the meaning of a word as it is used in a special context; or it could be to read in a fluent manner when requested to do so orally. A number of such specific examples could be cited as representative of this type of behavior.

However, the conditions which make reading a problem-solving activity are multidimensional. The individual is temporarily blocked from performing as he wishes or as he knows he should, but he is

not frustrated by the situation. He is still goal-motivated. The reader actively seeks alternate states, generates possible options for resolving the disparate condition, and selects the most efficient and successful reduction route for correcting the miscued stimulus.

Reduction of Uncertainty. Gibson states that reinforcement in reading "is not reduction of a drive, but reduction of uncertainty."[8] Smith, in his book *Understand Reading*, concurs with this position.[9] However, if reading is viewed as a problem-solving situation as depicted in figure 2, both conditions would be true, i.e., the reading process would contain elements of reduction of uncertainty and reduction of drive. The first condition sets up the active alternate states in the organism and the second reduces the tension when the goal is reached, that is, the disparate condition in the stimulus is resolved. For information to be processed (to provide perfect communication) from the author to the reader, any uncertainty contained in the written verbal material must be resolved.

The more unpredictable or uncertain the language unit is, the more difficult it is to recode, and thereby the more difficult to process and understand. However, perfect communication between writer and reader seldom if ever occurs, even if the reader himself was the author (for something written previously and read after some time interval). There always is "noise" in the communication system. The reader attempts to reduce this noise to a minimum so that as little interference as possible is present to effect the message transmitted.

Reduction of Word Perception Errors. To process written verbal material a reader must be able to recognize the words with a degree of rapidity. He must be able to pronounce (associate) them if necessary and, if appropriate, have established several sets of equivalencies for the stimulus. Any hesitancy, delay, or blockage increases the mediational effect; reaction time in establishing associational connections increases and the fluency is likely to be reduced.

When an individual reads orally, the reduction of uncertainty is expressed in the reduction of errors—a quantitative reduction. While it is true that a slight change in word order (a transposition) or a simple substitution may not change the final message significantly, such miscues do not contribute to the total reduction of the uncertainty of the situation. Even slight errors result in

TABLE I

ERROR VALUE RANGES FOR THE FIRST READING OF A SELECTION

	Primer–2[2]	3[1]–5[2]	6[1]+
Independent	1/17	1/27	1/36
Instructional	1/8 – 1/16	1/13 – 1/26	1/18 –1/35
Frustration	1/7	1/12	1/17

modification of the original message and therefore are significant in the total reading process.

This is not to say that reading must be perfect or exact to perceive the message. Such an assumption would be unfounded because fortunately, there is enough redundancy in language to allow for errors to occur and the message still to be transmitted. However, given enough errors within a normal range of values, the probabilities are that the information flow is reduced as that value range is exceeded. Much more research is needed to accurately determine the limits and the standard error of the expected range of errors both quantitatively and qualitatively.

Some of the research which Powell[10] and Dunkeld[11] have done in this area would be suggestive, but not definitive, of the normal error range which can be anticipated. This range of values is presented in table 1. Quantitatively, the number of errors tolerated is a differential function related to the readability of the material. In contrast, the work by Goodman and his associates has explored the qualitative dimensions of miscues and their findings have been a generative contribution to the field.[12] However, quantitative influences on reading behavior are reflected in their data.

Should a reader exceed the normal range of error values, he will have to make more corrections in order not to exceed the redundancy factors of the language and thereby not be able to deal with its unpredictability. For *instructional* purposes, clinical observations would suggest that this reduction factor might be 25 to 33 percent. This is best detected by observing a reader in repeated readings of the same material under differing performance requirements. An individual's first reading of a given selection will

likely reduce his errors on the second reading of the same material by about one-fourth to one-third. The second reading will reduce the number of perception errors by another 10 to 17 percent. Further readings are not likely to make significant changes in the quantitative factor as reading performance on a given piece of material stabilizes when the reduction values reach those upper limits. The data from a research study in process by Busboom may present further evidence on these reduction ranges.[13] Only further research will verify whether this clinical observation can be substantiated. Should it be verified, however, a basic operating principle will have been established which will permit the determination of the degree of reduction necessary for the differential requirements of performance for functional reading levels.

Since silent reading does not demand the pronunciation of every word, whether such a basic principle would apply across all developmental clusters must certainly be questioned. It is likely to apply in the first two cluster periods and not in the latter two. Surely, the nature of the silent reading task in the latter two periods shall reflect a difference. But how is it measured? The issue is not the appearance of error, but the amount of precorrection or correction necessary to stay within the redundancy factor of a given piece of written verbal material.

Reduction of Semantic Errors. Studies in cloze procedure clearly suggest that semantic differences occur with regularity between an author and his readers. The more basic the form class in which the differences occur, such as nouns and verbs, the higher the percent of agreement; but still agreement is far from unity. This would suggest that a reduction of uncertainty in the semantic components of a message need to take place in the same manner as word perception miscues. While I have not tried to find the reduction percentage for this dimension, I would not be surprised to learn that any such evidence will parallel a similar figure as hypothesized previously.

Reduction of Time. Any increased mediation time for reducing the word perception or the semantic factor has to increase the latency factor for a reader. Should there be little if any uncertainty in a given message, the time necessary to process its contents will be considerably reduced. However, given greater unpredictability in a

particular message, a longer latency period will be observed. Bartlett contends that "maybe the best single measure of mental skill lies in the speed with which errors are detected and thrown out, a function which becomes possible only when skill has first a symbolic expression."[14]

Increase of Syntactic/Semantic Clustering. The less need a reader has for reducing word perception errors and semantic errors, the greater potential he has for grouping words and phrases into more meaningful patterns or chunks. Reading becomes more creative and less atomistic. The reader begins to cluster ideas, not words, and to assimilate the ideas into his existing structure of knowledge. The greater the ability of significant chunking, the greater the reduction of time in processing.

Reduction of Drive. The autonomic nervous system is relaxed; tension is reduced. Regressive and fixating reading behaviors are reduced and affective and creative potential is released.

Problem Solved. Behavior continues to be constructive, versatile, and adaptive. The individual becomes more resourceful, and open to more options. The search for challenging alternatives continues.

BASIC OPERATING STRATEGIES

The most efficient processing of the reading repertoire would be for a reader to have a wide and deep reservoir of meaning so that upon the presentation of a graphic display he needs little reduction of word perception errors and moves directly to significant chunking, thereby reducing the latency period required. A study of the flow pattern in figure 2 would indicate there are many other alternate mapping routes available should the need arise. In all probability, there is a great deal of reverberation within and between the many possible combinations. Each problem situation will require different mapping conditions depending upon the nature of the difficulty.

The basic operating principle for efficient processing is one of reduction. Whether the errors or miscues are precorrected internally or overtly makes little difference. They must be reduced until the organism's structure of knowledge can assimilate the message. A match must be achieved between the redundancy factors of the language and the range of values tolerated for reduction. Each individual's matching system is undoubtedly unique but there

are probably modal values representative of a normal population. This modal value is believed to be about 25 to 33 percent for an instructional range and approximately 43 to 50 percent for material which is to be processed in an independent and relatively leisurely fashion. Only further research will confirm or deny whether this conjecture is correct.

This paper has presented aspects of acquiring a reading repertoire. The position taken here was that reading is broader than a skill—more like a repertoire with many abilities, aptitudes, and special accomplishments performing in concert. This repertoire is acquired by processing through four nonmutually exclusive developmental cluster periods where the skills to be learned *within* a given cluster are like the acquisition of language and are nonlinear. Within a cluster, a hierarchical set is probably insignificant. However, linearity is important in the interfacing period *between* clusters as the acquiring reader struggles to achieve new structures of knowledge. The linear effect during the interface time supplies the guidance and support when the learning challenge is the greatest, that is, the breaking-out of one developmental period into another.

During these development clusters and interfacing periods, the reader develops five strategies of processing the written verbal material. He learns to process recurring intact units which demand that he learn to discriminate between and within classes and to map the key features in relationship to itself and in space. A reader must learn to process time-space relationships which call for him to learn to associate and to establish equivalences. Given enough repeated exposures with the parameters of his learning rate, the prognosis for success is relatively high. Further, a maturing reader must learn to process semantic relations, to process transformations, and to psychologically differentiate ways of thinking using the printed page as the stimulus.

Theoretically, the nature of this process is one of problem-solving through the reduction of errors. The reader must learn to precorrect his errors, perceptually and semantically, until the redundancy factors of the presented material match his existing structure of knowledge. It was hypothesized that approximately one-third error reduction occurs under instructional conditions. A greater percentage of reduction would be necessary for independent recreational reading.

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4. Acknowledgement is given to the unpublished documents by Donald E.P. Smith, University of Michigan, which helped clarify the distinctions made regarding the first two tasks in this section.

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